## **CLAIMS**

Therefore, having thus described the invention, at least the following is claimed:

- 1 1. A method of fabricating a piezoelectric resonator from a semiconductor-on-
- 2 insulator substrate, the method including:
- forming trenches in a semiconductor layer of the semiconductor-on-insulator
- 4 substrate;
- removing an oxide layer from the semiconductor-on-insulator substrate;
- applying a piezoelectric material to the semiconductor layer; and
- 7 providing an electrode to the piezoelectric material.
- 1 2. The method of claim 1, further including patterning the piezoelectric material.
- 1 3. The method of claim 2, wherein the patterning includes wet etching using
- 2 ammonium chloride.
- 1 4. The method of claim 1, wherein the piezoelectric material is one of zinc oxide,
- 2 aluminum nitride, and lead zirconate titanate.
- 1 5. The method of claim 1, wherein the applying includes applying a thin film.
- 1 6. The method of claim 1, wherein the applying includes one of sputtering and high
- 2 temperature growth.
- 1 7. The method of claim 1, wherein the forming trenches includes one of deep
- 2 reactive ion etching and regular reactive ion etching.
- 1 8. The method of claim 1, wherein the forming oxide includes using hydro-fluoric
- 2 acid.

- 1 9. The method of claim 1, wherein the providing includes depositing aluminum
- 2 using electron beam evaporation.
- 1 10. The method of claim 1, wherein the forming, applying, and providing includes a
- 2 three-mask process.
- 1 11. The method of claim 1, wherein the forming, applying, and providing occurs at a
- 2 temperature of less than 250 C.
- 1 12. The method of claim 1, wherein the semiconductor material includes one of
- 2 silicon, germanium, single crystal semiconductor material, polycrystalline semiconductor
- 3 material, and amorphous semiconductor material.
- 1 13. A piezoelectric resonator, including:
- 2 a semiconductor material;
- 3 an electrode; and
- 4 a piezoelectric material disposed between the semiconductor material and the
- 5 electrode.
- 1 14. The piezoelectric resonator of claim 13, further including an oxide layer adjacent
- 2 to the semiconductor material.
- 1 15. The piezoelectric resonator of claim 14, further including a handle layer adjacent
- 2 to the oxide layer, wherein the oxide layer is disposed between the handle layer and the
- 3 semiconductor material.
- 1 16. The piezoelectric resonator of claim 15, further including a capacitor connecting
- 2 the semiconductor material to the handle layer, wherein the capacitor is configured to
- 3 receive a direct current voltage.

- 1 17. The piezoelectric resonator of claim 13, further including, in response to an
- 2 excitation force, a quality factor for a beam configuration that ranges between
- 3 approximately 2400-6200 for resonance frequencies ranging between approximately 1.72
- 4 megahertz –6.7 mega-hertz.
- 1 18. The piezoelectric resonator of claim 13, further including, in response to an
- 2 excitation force, a quality factor for a beam configuration that ranges between
- 3 approximately 3000-6200 for resonance frequencies ranging between approximately 1.72
- 4 megahertz 4.87 mega-hertz.
- 1 19. The piezoelectric resonator of claim 13, further including, in response to an
- 2 excitation force, a quality factor for a beam configuration that ranges between
- 3 approximately 5300-6200 for resonance frequencies ranging between approximately 1.72
- 4 megahertz –3.29 mega-hertz.
- 1 20. The piezoelectric resonator of claim 13, further including, in response to an
- 2 excitation force, a quality factor for a beam configuration that ranges between
- 3 approximately 5400-6200 for resonance frequencies ranging between approximately .721
- 4 megahertz 1.72 mega-hertz.
- 1 21. The piezoelectric resonator of claim 13, further including, in response to an
- 2 excitation force, a quality factor for a block configuration that ranges between
- 3 approximately 5500-11,600 for resonance frequencies ranging between approximately
- 4 16.9 megahertz 195 mega-hertz.
- 1 22. The piezoelectric resonator of claim 13, further including, in response to an
- 2 excitation force, a quality factor for a block configuration that ranges between
- 3 approximately 4700-11,600 for resonance frequencies ranging between approximately
- 4 16.9 megahertz 195 mega-hertz.

- 1 23. The piezoelectric resonator of claim 13, further including, in response to an
- 2 excitation force, a quality factor for a block configuration that ranges between
- 3 approximately 4500-11,600 for resonance frequencies ranging between approximately
- 4 16.9 megahertz 195 mega-hertz.
- 1 24. The piezoelectric resonator of claim 13, wherein the semiconductor material, the
- 2 electrode, and the piezoelectric material are configured in one of a beam configuration
- 3 and a block configuration.
- 1 25. The piezoelectric resonator of claim 13, wherein the electrode includes one of a
- 2 sense electrode and a drive electrode.
- 1 26. The piezoelectric resonator of claim 25, wherein the sense electrode and the drive
- 2 electrode are separated by the piezoelectric material.
- 1 27. The piezoelectric resonator of claim 25, wherein the sense electrode and the drive
- 2 electrode are separated by the surface of the semiconductor material.
- 1 28. The piezoelectric resonator of claim 13, wherein the thickness of the
- 2 semiconductor material ranges between approximately 0.2-30 microns.
- 1 29. The piezoelectric resonator of claim 13, wherein the piezoelectric material
- 2 includes one of zinc oxide, aluminum nitride, and lead zirconate titanate.
- 1 30. The piezoelectric resonator of claim 13, wherein the semiconductor material
- 2 includes one of silicon, germanium, single crystal semiconductor material, polycrystalline
- 3 semiconductor material, and amorphous semiconductor material.
- 1 31. The piezoelectric resonator of claim 13, further including an adhesion layer
- 2 disposed between the piezoelectric material and the semiconductor material.

- 1 32. The piezoelectric resonator of claim 13, further including at least one of in-plane
- 2 and out-of-plane voltage tunability.
- 1 33. A communications device, including:
- 2 a receiver; and
- a piezoelectric resonator disposed in the receiver, the piezoelectric
- 4 resonator including:
- 5 a semiconductor material;
- 6 an electrode; and
- 7 a piezoelectric material disposed between the semiconductor material
- 8 and the electrode.
- 1 34. The communications device of claim 33, wherein the piezoelectric resonator is
- 2 configured as at least one of a filter and a frequency reference device.
- 1 35. The communications device of claim 33, further including a transmitter.
- 1 36. The communications device of claim 35, wherein the transmitter includes a
- 2 second piezoelectric resonator, wherein the second piezoelectric resonator is configured
- 3 as at least one of a filter and a frequency reference device.